

Balancing Agricultural Productivity and Environmental Pollution

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ABSTRACT: Agriculture is backbone of several developing economies around the globe, specifically in countries where cheap labor and agri-resources are found in ample with favorable environmental conditions. Agriculture is source to generate employment, establish market and provide economic opportunities at local and national level. In all, it is an important source of livelihood and serves as an important factor for strengthening local and national economy. In race to improve all the three factors viz. employment, market and economy; institutions are supporting various means and measures to improve agriculture productivity and agri-based income. The rising agricultural surplus caused by increasing agricultural production and productivity tends to improve social welfare, particularly in rural areas. This paper outlines the parameters where we need to create balance in our agriculture, economic and environmental policies; it also talk about environmental evils created due to improper usage of inorganic substances and other toxic substances to achieve better productivity.

KEYWORDS: Agriculture, Environment, Inclusive Growth, Policy, Pollution

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I. INTRODUCTION

Agriculture is a backbone of several economies around the globe, specifically in countries where population is large and resources are in ample with conditions favorable to agriculture at large. Agriculture provides employment opportunities for rural people on a large scale in underdeveloped and developing countries. It is an important source of livelihood and serves as an important factor for strengthening local and national economy. The rising agricultural surplus caused by increasing agricultural production and productivity tends to improve social welfare, particularly in rural areas.

The basic assumption where increase in agricultural production is directly related with improved social welfare and hence the living standard of the rural poor or population dependent upon agriculture based income; there is another factor which do attract attention of only the environmentalists i.e. pollution caused by the chemical based products used for improving the production and productivity.

In the recent study conducted by WB with other ground level local organizations, it has been found that the countries where population is high and resources for agriculture development is limited, the level of pollution dependent on agriculture is higher than other set of countries / economies.

According to report – “Agricultural intensification and growth have provided a solid footing for East Asia’s development over the past three to five decades, but it is now time for the agricultural sector to address its expanding pollution footprint. Regional agriculture has largely succeeded—despite significant intraregional disparities—at feeding some of the world’s fastest-developing societies”.

Agricultural pollution is a concern in every country where farming has taken an intensive turn—indeed, even where very small farms continue to dominate. The changing face of farm mechanization and concentration, together with the continued importance of small yet intensive household farm operations, pushes traditional agriculture towards use of inorganic substance and hence professing farm pollution - even though the relationship between these phenomena is far from linear and varies by subsector, farming context, and form of pollution, but still it shows a positive relationship between the two.

Agricultural pollution in some Asian countries is likely harming human, animal, and ecosystem health; climate stability; farm productivity and agroindustry competitiveness; as well as other commercial interests and quality of life. Even when they are not directly measured, levels of pollution attributable to agriculture (such as soil and air pollution) can be inferred from farming practices. The intensity of agricultural pollution do have adverse socioeconomic effects, its economic costs are also high.

The issue is not a simple one as it looks like in cursory view, this far beyond normalcy. Most of these agriculture intensification programs are supported by government/s at local, national and global level; these inorganic input materials gets subsidy from government and finance to agriculture is provided at a very low cost to improve the financial inclusion status of the country and hence support in achieving the SDG goals. Political fraternity look at this sector with a lens of employment, local political gains and household development;

improved productivity and income help political ruling parties to show minimal below poverty line population. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents made present in coming section shall provide more information about the topic, related critical issues and some potential solutions to handle the situation before it gets out of control.

Objectives: The following broad objectives have been adopted for this paper.

1. To examine the current status of environment pollution happening because of achieving higher agriculture production.
2. To know the relevance and scope of agriculture productivity in environmental pollution.
3. To examine the areas of interference in policy laid down by states to bring in balancing factor in agri-production and related environment pollution.
4. To identify the ways and means to curb down environmental pollution, adopting better package of practice.

II. METHODOLOGY

The data collected through the journals, magazines, reports and various websites. The collected data and observation based details have been analyzed to achieve the pre-set objectives of this paper.

III. AGRICULTURE PRODUCTIVITY

In simple terms Agriculture Productivity is the ratio of agricultural outputs to agricultural inputs. Measuring it is a critical issue, as the density of agriculture production with varying conditions differ in different geography. Out of many sources available, this paper focuses more on usage of inorganic input supplies to harvest more per acre. More production leads to better socio-economic conditions and economic welfare.

The productivity of any land is important for various reasons, e.g. food security, increase in local prospects for growth and strengthening of competitive agricultural market, better income distribution and increased savings, and labour migration. Increase agriculture based production, implies better inclusive development in the whole area to all segments of population creating a balance between the distributions of available resources to all. As farmers adopt new techniques and differences, the more productive farmers benefit from an increase in their welfare while farmers who are not productive enough will exit the market to seek success elsewhere.¹

Increases in agricultural productivity lead also to agricultural growth and can help to alleviate poverty in poor and developing countries, where agriculture often employs the greatest portion of the population. As farms become more productive, the wages earned by those who work in agriculture increase. At the same time, food prices decrease and food supplies become more stable. Labourers therefore have more money to spend on food as well as other products. This also leads to agricultural growth. People see that there is a greater opportunity to earn their living by farming and are attracted to agriculture either as owners of farms themselves or as labourers. However, it is not only the people employed in agriculture who benefit from increases in agricultural productivity. Those employed in other sectors also enjoy lower food prices and a more stable food supply. Their wages may also increase.²

Increase in population around the globe is giving boost to demand side, matching this requires incremental growth of production; countries like India and China with large population are facing an unbalancing issue of agri-productivity Vs Environmental pollution. India, one of the world's most populous countries, has taken steps in the past decades to increase its land productivity. Forty years ago, North India produced only wheat, but with the advent of the earlier maturing high-yielding wheats and rices, the wheat could be harvested in time to plant rice. This wheat/rice combination is now widely used throughout the Punjab, Haryana, and parts of Uttar Pradesh. The wheat yield of three tons and rice yield of two tons combine for five tons of grain per hectare, helping to feed India's 1.1 billion people.³

IV. ENVIRONMENT POLLUTION DUE TO AGRI-ACTIVITY

The positive side of agriculture were explained in previous section, while there are certain grey side of this activity; specifically when input supplies are inorganic and the main motive of agriculture is profit

¹ Mundlak, Yair, "Agricultural Productivity and Economic Policies: Concepts and Measurements," OECD Working Paper No. 75, OECD Development Center, August 1992, Source OECD.org, 13 July 2007 <http://miranda.sourceoecd.org/vl=4172647/cl=20/nw=1/rpsv/cgi-bin/wppdf?file=5lgsjhvj7g21.pdf> (13–16).

² Promoting Pro-Poor Growth: Agriculture, DAC Guidelines and Reference Series, Paris: OECD, 2006, OECD.org, 13 July 2007

³ Brown, Lester R. Plan B 2.0: Rescuing a Planet Under Stress and a Civilization in Trouble. New York City: Earth Policy Institute, 2006.

maximization on the cost of denying environmental pollution. Let's start with various kind of agriculture related pollution and their significance:



4.1 Water Pollution and Agriculture

In accordance with the data published by National Summary of Assessed Waters Report in 2010, approximately 53 % of global rivers and streams have been declared unfit for the designed use (Rabotyagov et al. 2012). The Royal Commission of Environmental Pollution (RCEP) published the 7th report called "Agriculture and Pollution" in 1979. The report discussed the impacts of various contributors used in agricultural practices such as fertilizers and pesticides; however, at present "pollution" has taken wider perspective because of the increased understanding of the functioning of complex system (Moss 2008).

Some elements like phosphorous, nitrogen, and a few other minerals are known as scarce elements, which have been largely depleted from landscapes due to excessive deforestation and extensive agriculture (Likens et al. 1977). Moreover, naturally selected species have efficient root system and microorganisms capable of retaining soil particles and minerals by forming protective soil crusts. Obviously, such landscapes will be affected by natural disasters like volcano, hurricanes, and tree falls, but such natural events are inevitable. Moreover, the after effects like exposure of soil and its erosion can be faded by successful succession of species that eventually re-stabilizes the soil surface (Moss 2008).

4.1.1 Pesticides causing pollution

Individual pesticides have unique properties, and many variable factors determine the specific risk in terms of water pollution. Pesticides and filtrates including nitrates and phosphates can swiftly elate to contaminate ground water and fresh water supplies over a large area. Pesticides when come in contact with soil, gets disintegrated through microbial activity; its speed actually defines the degradation level. Loss of pesticide residues can also occur by evaporation and photodecomposition.

Another factor effecting pesticide pollution of water is rainfall as high levels of rainfall increase the risk of pesticides contaminating water. Movement into water courses occurs directly by washing from pest and target areas into drains after rainfall. It can also occur within the soil structure by displacement of pesticide from absorption sites by water and on treated soil which has moved to water through soil erosion.

A number of pesticides function as endocrine disruptors (ED). ED by blurring as endocrine hormones in human body interferes with the natural physiological functions and disrupts them. Some of the examples are brominated diphenyl esters, polychlorinated biphenyls, and phthalate esters (Ozen et al. 2011). Atrazine, an herbicide, is harmful for the reproductive development of humans. It also has a major role in causing cancers like adrenocortical carcinoma, ovarian cancer, and placental cancer by increasing aromatase expression (Jessica et al. 2012). A systemic insecticide Phorate (PHR) causes problems in nerve impulse transmission by inhibiting cholinesterase enzyme (Timoroglu et al. 2012).

The health effects of pesticides depend on the type of pesticide. Some, such as the organophosphates and carbamates, affect the nervous system. Others may irritate the skin or eyes. Some pesticides may be carcinogens (they may cause cancer). Others may affect the hormone or endocrine system in the body. Regulatory agencies have long agreed on the presence of and the effects of pesticides in drinking water

sources. However, understanding the potential effects of chemical mixtures on humans and the environment is one of the most complex problems facing scientists and regulatory agencies.⁴

4.2 Air Pollution and Agriculture

Air pollution is the term used to describe the contamination due to some unwanted materials: solid, liquid, or gaseous substances present in the environment. Agricultural field is related to air pollution in two ways; firstly, nonagricultural resources give rise to air pollutants that can affect agricultural crops directly and secondly, allied activities give rise to pollutants affecting air, environment, and other areas. It has an adverse impact on crop's production, quality, and yield. Crops can be badly affected, but the severity depends upon the amount of pollutants and certain other conditions that are unfavorable for growth of the crops (Agrawal 2005). These pollutants can be toxic chemicals, greenhouse gases, and other harmful airborne particles. Some of these pollutants are described below:

- a) Ozone
- b) Sulphur Di Oxide
- c) Fluorides
- d) Green House Gases (e.g. Carbon Di Oxide, Nitrogen Oxide)
- e) Soil Erosion

There are certain activities and ways by which agriculture pollutes environment:

a) Agriculture burning - It is the process of burning waste material coming from agricultural practices and is carried out for clearance of land, shrubs, pests, and production of better quality crops by getting nutrients from the land. The by-products of this process include certain chemical substances, smoke, and particulate matter, which pollute the air and are harmful for health. This also releases carbon, carbon dioxide, carbon monoxide, and sulfur dioxide, which not only affect atmosphere but also the crops (Jenkins et al. 1996). These contaminants result from a combustion process carried out at low temperature (Werther et al. 2000). Residual waste of rice and wheat usually contributes to the production of many gases (Venkataraman et al. 2006).

b) Uses of fertilizers – To achieve better quality product and higher production, fertilizers are added to the soil; these can be chemical or mineral fertilizers with nitrogen, phosphorous, and potassium as primary nutrients within. If increased quantity of chemical fertilizers is applied to plants, it affects the air and releases nitrogen oxides such as NO, NO₂, and N₂O causing air pollution (Savci 2012). The use of fertilizers has been decreased in the developed nations of the world because of their impact on the environment, but is still used in excessive quantity in underdeveloped countries. Fertilizers result in the emission of 1.2 % of greenhouse gases into the environment (Kongshaug 1998). Ammonium fertilizers result in the emission of ammonia gas, which gets converted to nitric acid resulting in the acidic rain and then affects the crops.

c) Rice field as a source of Methane gas - The fields in which rice is grown are flooded with water (paddy fields), which are an important source of methane gas production (Zhuang et al. 2009). These fields provide favorable conditions to the methanogenic bacteria like humidity, organic substances, and environment limited in oxygen supply. When organic matter is decomposed, carbon dioxide, hydrogen gas, and acetate are produced. The methanogenic bacteria carry out the conversion of these substances into methane gas, which ultimately pollutes the air (Sandin 2005).

d) Particulate matter - It is the mixture of sulfate, organic and elemental carbon, solid compounds, dust, nitrate, smoke, and small droplets of liquid (Jacob and Winner 2009). Their diameter ranges from >2.5 µm to <10 µm. It can also be resulted from wind erosion, tillage process performed to prepare land for agricultural purposes, by burning of crops, and can be formed during the reactions of sulfur and nitrogen oxides. They badly affect the vegetation by interfering with the pesticides. Besides this, alkaline dust may increase the alkalinity of the cultivating land, inhibiting the crop growth and death of leaf tissue (Lemke et al. 2004).

4.3 Climate Change and Agriculture

Climate change is referred to as changes and variations that occur in climate and persist for a longer period of time ranging from a few years to many decades. There are reasons for this change in climate can be many; it can be due to natural processes occurring in the earth's atmosphere or anthropogenic changes (effect of humans on environment). Agriculture has obtained a central role while studying the potential effects of climatic change (Decker et al. 1986).

The consequences of agriculture on climate and the outcome of climate change on agriculture are interlinked to each other. The most important link between these two is "the greenhouse gases." As much as GHG affect the agriculture and crop production, studies on agriculture's contributions to trace gas emissions have increased in the past few decades (Adams et al. 1990). Agriculture practices such as use of nitrogen

⁴ <https://www.safewater.org>

fertilizers and synthetic pesticides emit approximately one-quarter of global anthropogenic greenhouse gases (Scialabba and Lindenlauf 2010).

In the twentieth century, global warming is mainly because of the anthropogenic increase in GHG (Crowley 2000). A high concentration of greenhouse gases produces radiative forcing which tends to warm the surface of the earth (Houghton et al. 2001). The increased concentration of greenhouse gases has led to increased warming of the earth due to positive radiative forces. Increased emission of carbon dioxide is attributed to the expansion in land used for agriculture besides fossil fuels and burning of green plants and forests. Expansion of agriculture has resulted in soil degradation, decrease in soil organic carbon and nitrogen, and increase in emission of atmospheric carbon dioxide, nitric oxide, and methane either by converting natural systems into agricultural system (deforestation, biomass) or by soil management practices (use of fertilizers) (Tavi and Lal 2013). The application of different practices including reduced tillage systems, management of crop residues, nutrient and pest management and their control, agroforestry, use of biochar as soil amendment, and other agricultural technologies are some recommended managing practices which will help in reducing the impact of agriculture on climate and environment (Tavi and Lal 2013).

Challenges due to climate change arising from increased farming practices can be fought by agricultural communities, thus leading to reduced GHG emissions by simple strategies such as farming with perennials, livestock production in climate friendly manner, increasing soil carbon level, and providing protection to the natural habitats (Scherr and Sthapit 2010).

Studies have identified the source and reasons of pollutants being used, which concludes with the suggestion on how to handle these pollutants and curb agriculture pollution. A broad array of technical as well as policy instruments are suggested in several research reports published.

V. THE BALANCING FACTORS

According to Malthusian view, the rate of increasing number of people is more than the earth's space; this leads to imbalance between food security and environmental destruction. The current population of planet Earth calls for agricultural sustainability to ensure solution of problems like food security and ecological degradation, as these are directly linked to each other. The threats to achieve sustainability in agriculture give rise to a discernment of focusing on instant profit and production. Sustainability can only be achieved, if we give priority to the long-term benefits of ecological stability and conservation of biodiversity over short-term benefits of yield gains and commercial goals. In short, the agricultural sustainability means the productivity in continuity without any fatigue, and for this the agricultural practices should be eco-friendly (Kesavan and Swaminathan 2008). The practices that are required for agricultural sustainability should have three characteristics: no harmful effects on ecosystem, easily available for farmers, and increase in food production (Pretty 2007). The herbicides with novel characteristics should be produced to overcome the resistance of weeds to already available herbicides (Duke 2012). Today food security is a major problem. To solve this problem, sustainable food production and organic farming can be proved very helpful (Paoletti et al. 2010). We should be instrumental in making policies and best practices bouquet, which includes the following:



VI. CONCLUSION

Three important pillars to solve this can be Policy, Production and Pollution are correlated with each other. It is considered that agriculture is affected by the environmental pollution, but there is always the other

side of the story too. Two aspects of agriculture have been discussed in detail. One is the pollution caused by the agriculture and the other is the impact of pollution upon agriculture. Agricultural pollution not only affects air, water, and soil, but problems related to health and biodiversity have also been observed through the use of fertilizer, pesticides, organic matter, and greenhouse gas emissions. There will be an alarming situation when agricultural pollution will minimize the agricultural yield itself.

All this calls for a simple yet strong policies to give direction to present agriculture sector, some of the suggestion do need support from the private stakeholders too. Green Agriculture awareness is another area of strengthening among many others, in nut shell the steps to tackle this problem are mentioned below:

1. Change in animal/fish breed, feed and shelter
2. Water waste treatment
3. Lower down the use of inorganic toxic input supply
4. Introducing manure making instead of burning crop residue
5. Cohesive government policies to curb pollution yet supporting agriculture
6. Invest in innovation and research areas

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